US006839613B2

(12) **United States Patent**
McCarthy et al.

(10) **Patent No.: US 6,839,613 B2**
(45) **Date of Patent: Jan. 4, 2005**

(54) **REMOTE TUNING FOR GAS TURBINES**

(75) Inventors: **John Patrick McCarthy**, Rochester, NY (US); **Andrew Philip Shapiro**, Schenectady, NY (US); **George Edward Williams**, Niskayuna, NY (US); **Eric Gardner Butterfield**, Watervliet, NY (US); **Scott Campbell Mattison**, Salem, VA (US); **Victor Franz Russo**, Woodstock, GA (US); **Milton Lewiston Grant, III**, Washington, DC (US)

(73) Assignee: **General Electric Company**, Schenectady, NY (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 424 days.

(21) Appl. No.: **09/906,001**

(22) Filed: **Jul. 17, 2001**

(65) **Prior Publication Data**

US 2003/0018394 A1 Jan. 23, 2003

(51) **Int. Cl.**[7] **G05D 11/00**

(52) **U.S. Cl.** **700/287**; 60/39.281; 60/773; 60/776

(58) **Field of Search** 700/287, 288, 700/286, 290; 60/39.27, 39.281, 725, 773; 431/114

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,787,053 A		11/1988	Moore	
4,803,639 A		2/1989	Steele et al.	
4,843,557 A		6/1989	Ina et al.	
4,992,946 A		2/1991	Butz et al.	
5,211,004 A		5/1993	Black	
5,319,931 A		6/1994	Beebe et al.	
5,411,712 A		5/1995	Woodmansee et al.	
5,423,175 A		6/1995	Beebe et al.	
5,487,265 A		1/1996	Rajamani et al.	
5,487,266 A		1/1996	Brown	
5,487,275 A		1/1996	Borkowicz et al.	
5,488,784 A		2/1996	Woodmansee et al.	
5,489,738 A		2/1996	Abramowicz et al.	
5,491,970 A		2/1996	Davis, Jr. et al.	
5,544,478 A		8/1996	Shu et al.	
5,551,228 A	*	9/1996	Mick et al.	60/776
5,608,627 A		3/1997	Lecomte et al.	

(List continued on next page.)

FOREIGN PATENT DOCUMENTS

EP	1 168 121	1/2002
EP	1 168 130	1/2002

OTHER PUBLICATIONS

Patent Abstracts of Japan, Kenichi, Publication No. 11202931, Publication Date Jul. 30, 1999, Plant Operation Monitoring and Operating Device, 1 page.

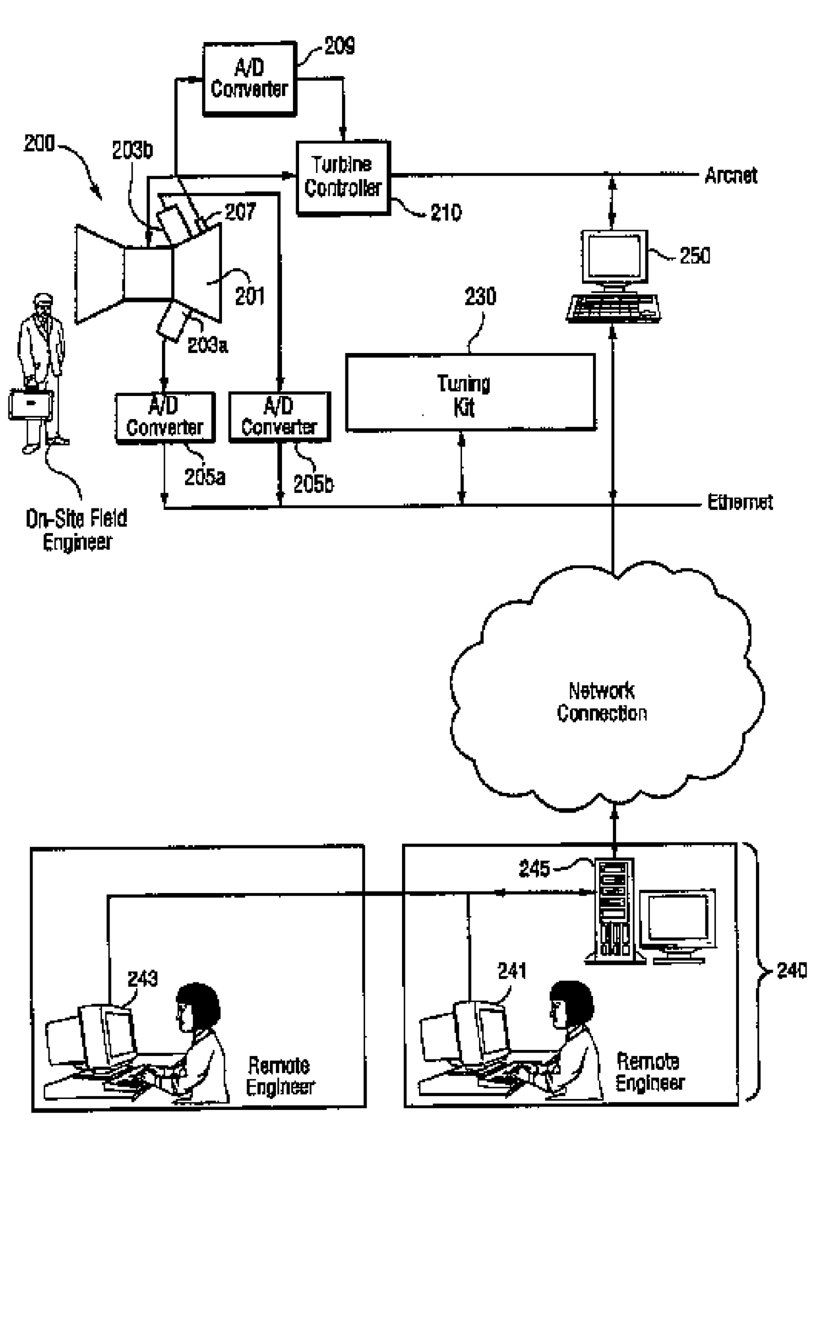
Patent Abstracts of Japan, Hiroshi, Publication No. 2002138895, Publication Date May 17, 2002, Internal Combustion Engine Control Device and Data Communication System Using Internal Combustion Engine Control Device, 1 page.

Primary Examiner—Leo Picard
Assistant Examiner—Charles R Kasenge
(74) *Attorney, Agent, or Firm*—Nixon & Vanderhye P.C.

(57) **ABSTRACT**

A system and method for tuning a turbine comprises a turbine controller coupled to the turbine, a first computer system coupled to the turbine controller and located locally to the turbine, and a second computer system for exchanging data with the first computer system. The second computer system is located remotely from the turbine and exchanges data with the first computer system via a network connection such as the internet, an intranet or a virtual private network (VPN). Data relating to a characteristic such as turbine combustion dynamics and/or emissions is transmitted by the first computer system to the second computer system. The second computer system transmits control data over the network connection to the first computer to tune the turbine.

22 Claims, 6 Drawing Sheets



U.S. PATENT DOCUMENTS

5,636,507 A		6/1997	Rajamani et al.
5,661,969 A		9/1997	Beebe et al.
5,706,896 A		1/1998	Tubel et al.
5,729,968 A		3/1998	Cohen et al.
5,937,634 A		8/1999	Etheridge et al.
5,975,204 A		11/1999	Tubel et al.
6,073,479 A		6/2000	Shapiro et al.
6,082,092 A		7/2000	Vandervort
6,110,321 A		8/2000	Day et al.
6,155,098 A		12/2000	Shapiro et al.
6,197,187 B1		3/2001	Thornton et al.
6,205,765 B1		3/2001	Iasillo et al.
6,250,063 B1		6/2001	Davis, Jr. et al.
6,255,551 B1		7/2001	Shapiro et al.
6,260,004 B1		7/2001	Hays et al.
6,269,299 B1		7/2001	Blotenberg
6,354,071 B2		3/2002	Tegel et al.
6,499,114 B1		12/2002	Almstead et al.
6,584,434 B1		6/2003	Schick et al.
6,591,296 B1		7/2003	Ghanime
2002/0029097 A1	*	3/2002	Pionzio et al. 700/287
2004/0128146 A1		7/2004	Williams et al.

* cited by examiner

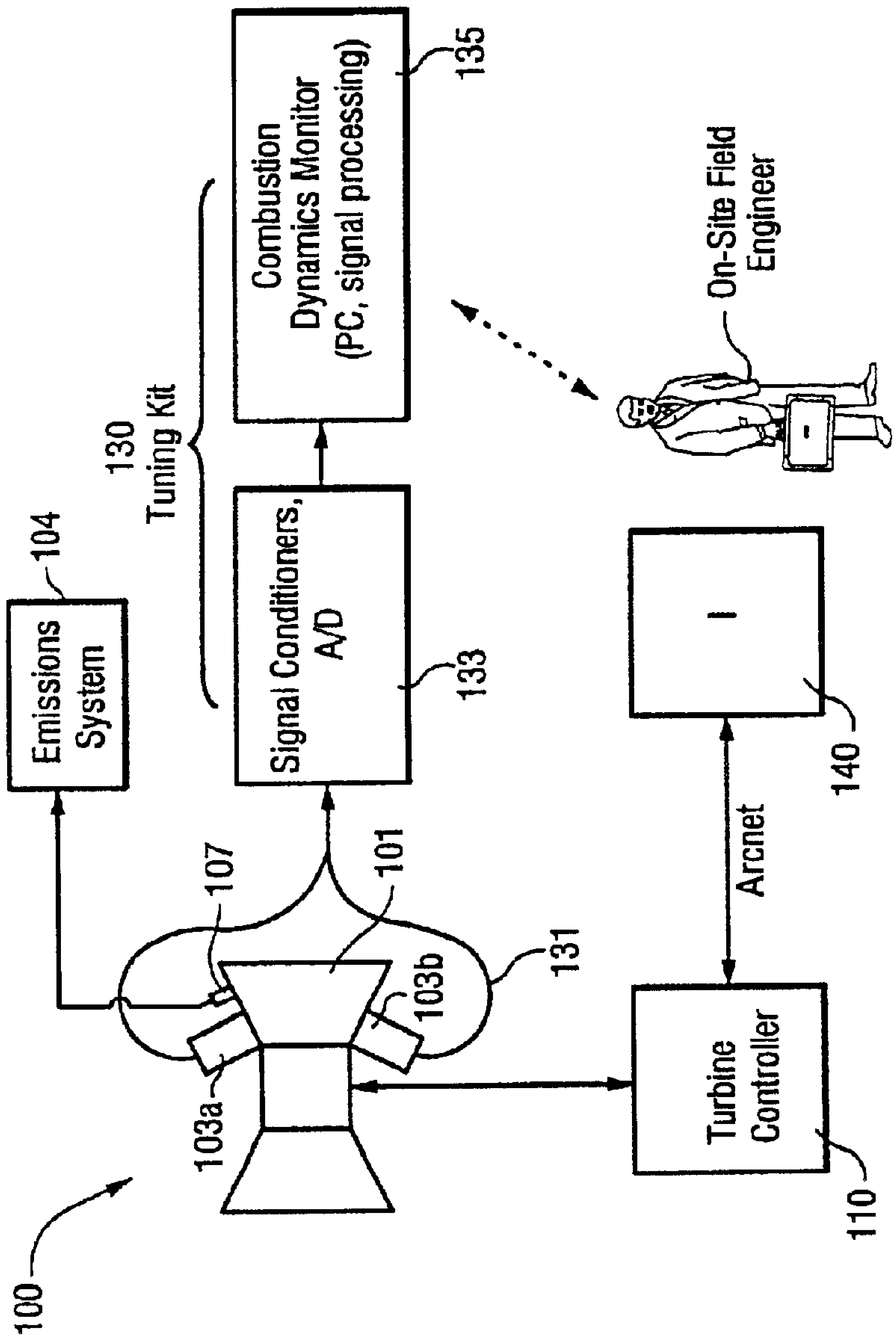


Fig. 1
(PRIOR ART)

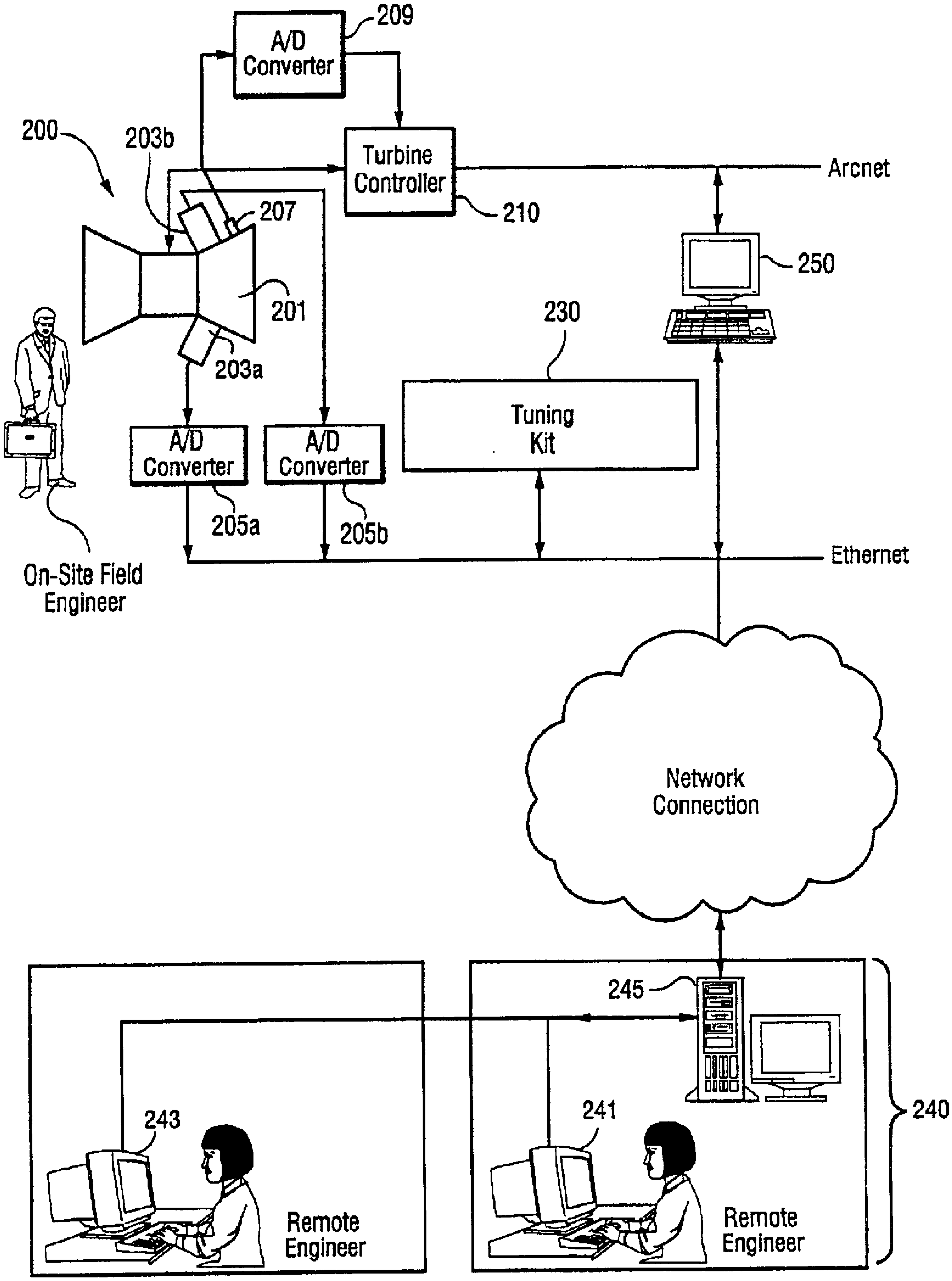

209
A/D Converter
200
203b
Turbine Controller
Arcnet
207
210
250
201
230
203a
Tuning Kit
A/D Converter
A/D Converter
205a
205b
Ethernet
On-Site Field Engineer
Network Connection
245
240
243
241
Remote Engineer
Remote Engineer

Fig. 2

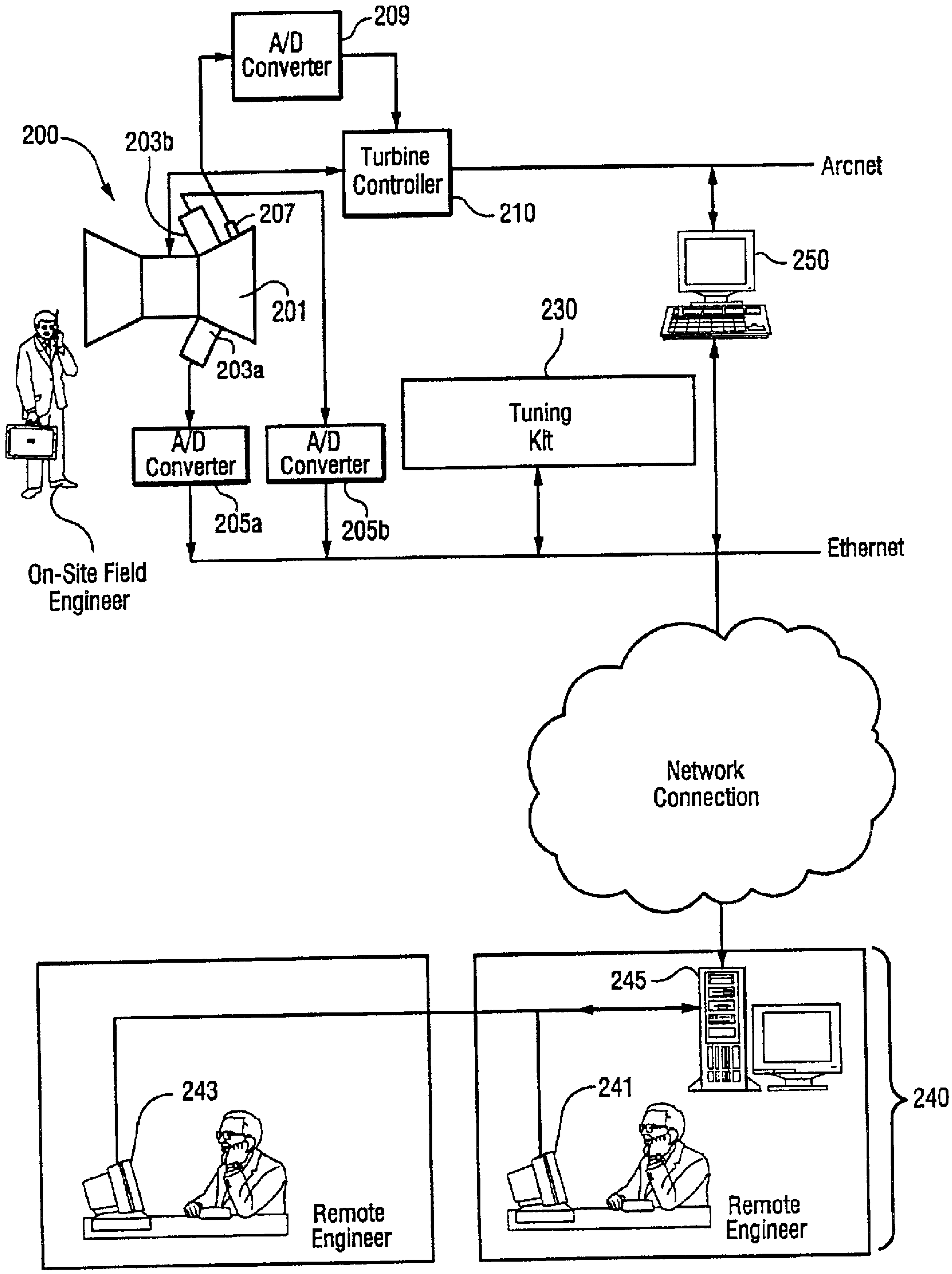
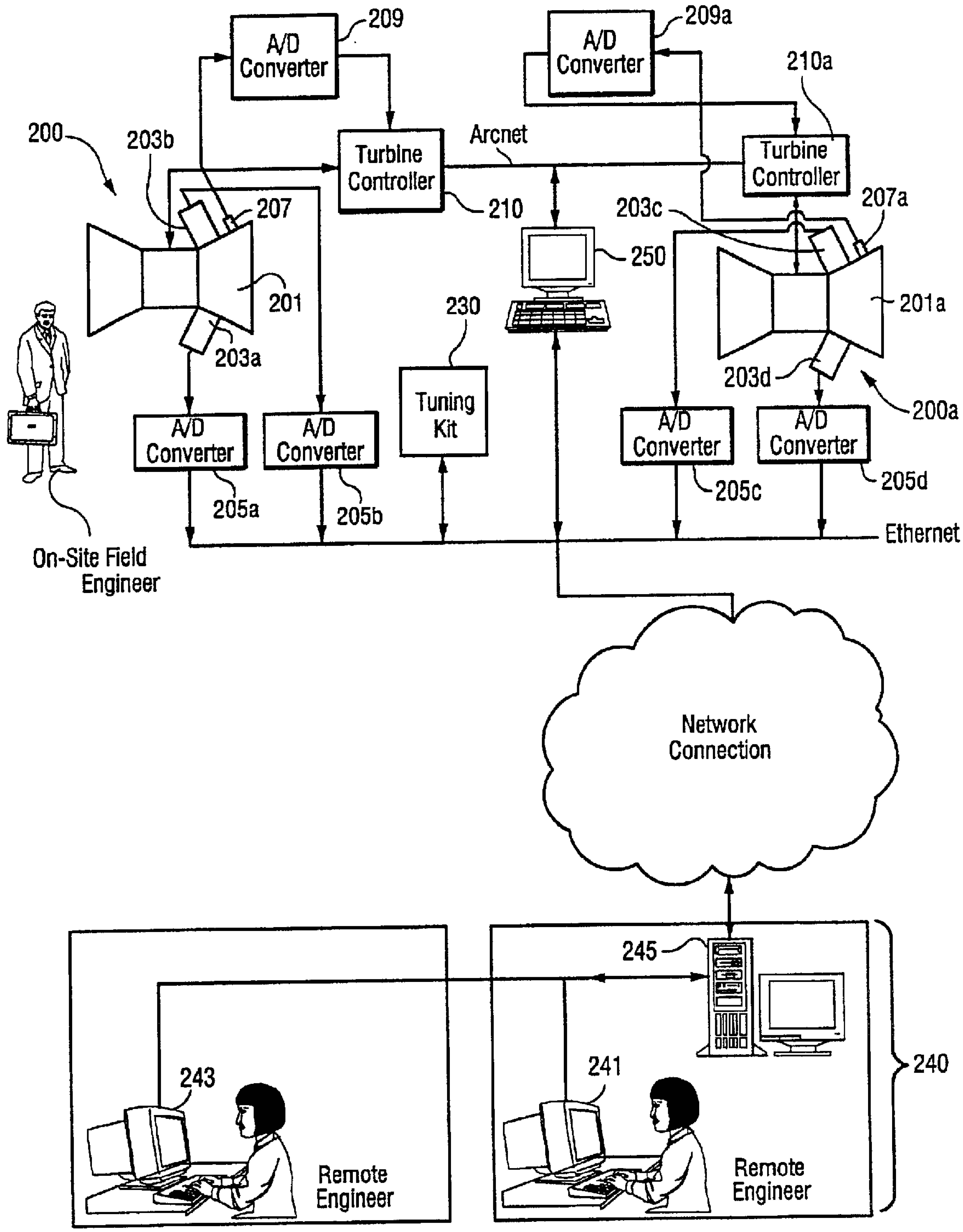
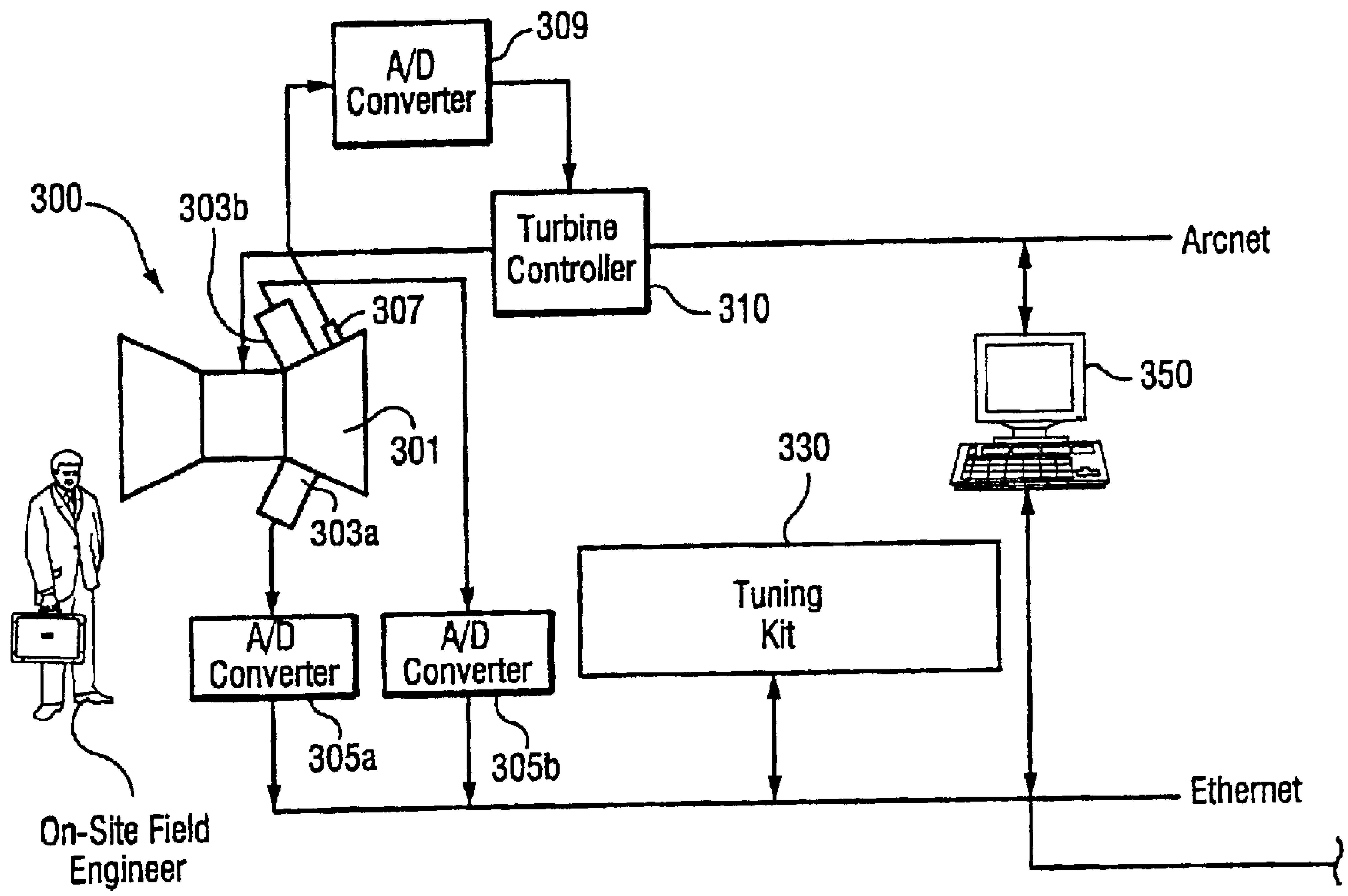

209
A/D Converter
200
203b
Turbine Controller
Arcnet
207
210
250
201
230
203a
Tuning Kit
A/D Converter
A/D Converter
205a
205b
Ethernet
On-Site Field Engineer
Network Connection
245
243
241
240
Remote Engineer
Remote Engineer

Fig. 3



A/D Converter
209
A/D Converter
209a
210a
200
203b
Turbine Controller
Arcnet
Turbine Controller
207
210
203c
207a
250
201
230
201a
203a
203d
200a
A/D Converter
A/D Converter
Tuning Kit
A/D Converter
A/D Converter
205c
205d
205a
205b
Ethernet
On-Site Field Engineer
Network Connection
245
243
241
240
Remote Engineer
Remote Engineer

Fig. 4



A/D Converter
309
Turbine Controller
310
Arcnet
300
303b
307
301
303a
350
330
Tuning Kit
A/D Converter
A/D Converter
305a
305b
Ethernet
On-Site Field Engineer

Fig. 5A

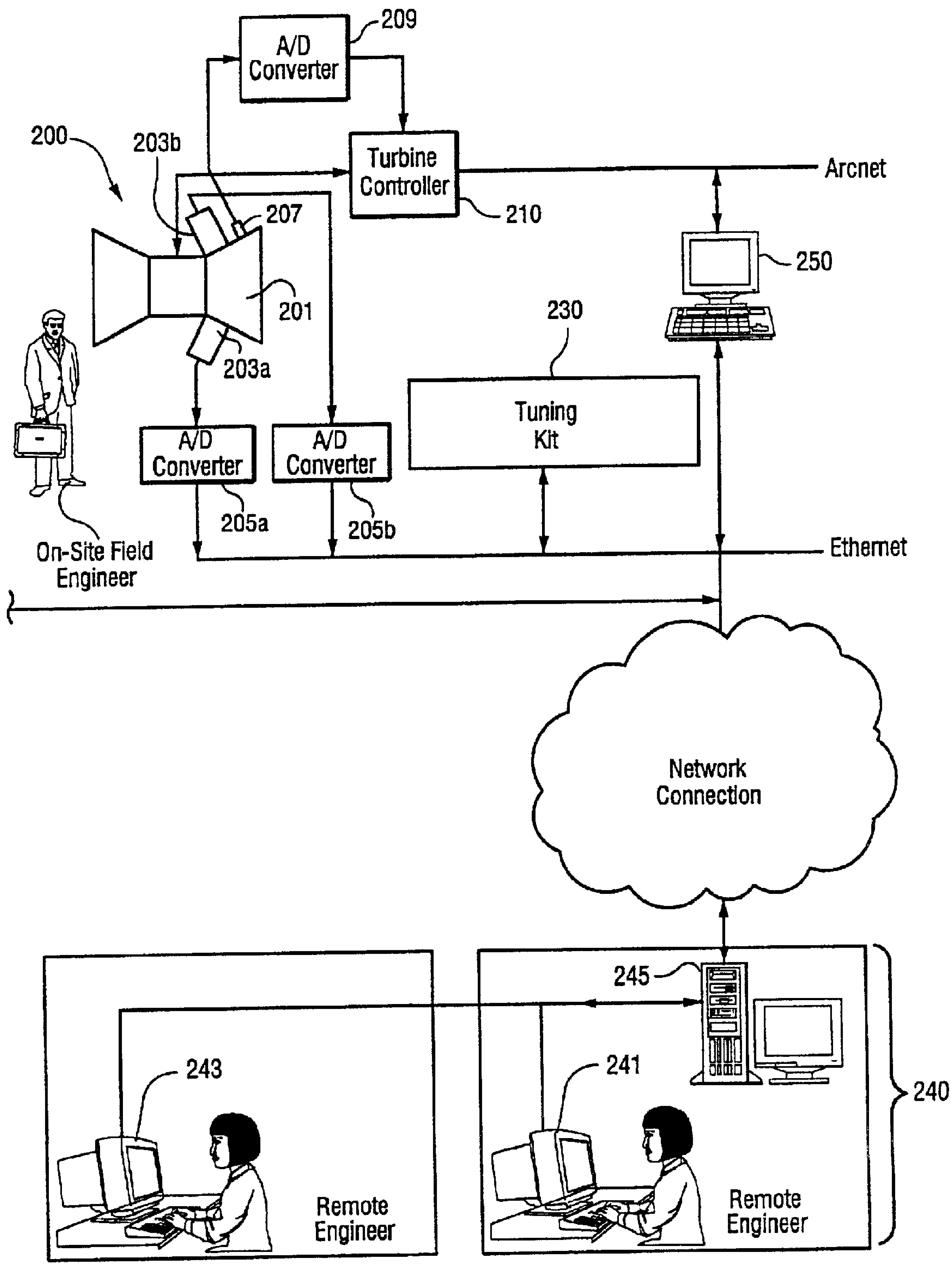

209
A/D Converter
200
203b
Turbine Controller
Arcnet
207
210
250
201
230
203a
Tuning Kit
A/D Converter
A/D Converter
205a
205b
Ethernet
On-Site Field Engineer
Network Connection
245
243
241
240
Remote Engineer
Remote Engineer

Fig. 5B

REMOTE TUNING FOR GAS TURBINES

BACKGROUND OF THE INVENTION

The present invention relates to a system and method for tuning a gas turbine, and in particular, to a system and method for tuning a gas turbine from a remote computer.

FIG. **1** schematically illustrates a conventional gas turbine system. The system includes a gas turbine **100** having, inter alia, a plurality of combustion chambers **101**, a plurality of pressure transducers **103***a*, **103***b* installed in respective combustion chambers **101** for measuring pressure therein, an emission sensor **107** installed in each of the combustion chambers **101** for measuring emissions therein, and a fuel manifold (not shown) for controlling and providing fuel splits to the turbine **100**.

A tuning kit **130** including a signal conditioner **133** and a dynamics monitor **135** is operatively coupled to the gas turbine **100**. Specifically, the signal conditioner **133** is connected through a coaxial cable **131** to the pressure transducers **103***a*, **103***b* for receiving raw data signals from the pressure transducers **103***a*, **103***b*. The signal conditioner **133** processes the received raw data signals by providing an analog to digital conversion to the raw data and outputs corresponding signals to the combustion dynamics monitor **135**. The combustion dynamics monitor **135** includes a computer that provides further signal processing to the received signals and ultimately generates a fast fourier transform (FFT) from which maximum amplitudes and frequencies of the combustion dynamics of the turbine **100** can be determined.

An emissions system **104** is connected to the emissions sensors **107** (one shown) to provide data regarding the amount of substances such as NO_x and CO in the exhaust of the turbine **100**. An on-site engineer can analyze the amplitude and frequency data generated by the combustion dynamics monitor **135** and/or emissions system **104** and determine any necessary adjustments to the gas turbine **100** such as an adjustment to the fuel split settings.

A turbine controller **110** such as a Mark V turbine controller is operatively connected to the turbine **100**. A processor such as an "I" processor **140** is connected to the turbine controller **110** for exchanging data using Arcnet protocol. After the engineer determines the necessary changes to the gas turbine **100**, the engineer can provide an input into the processor **140** such as new fuel split control values to implement the changes. The processor **140** provides the control values to the turbine controller **110** which, in turn, provides a corresponding signal to the turbine **100** so that the turbine **100** can be tuned to the new settings reflecting the input into the processor **140**.

After the gas turbine **100** has adjusted to the new settings, the engineer will make another set of measurements through the pressure transducers **103***a*, **103***b* and/or emissions sensors **107** to thus obtain another measurement of the combustion dynamics and/or emissions of the turbine **100**. This process is repeated until a map of combustion dynamics and/or emissions as a function of fuel splits and operating mode is developed. Using this map, the engineer can determine the optimum fuel split settings to achieve low emissions and low dynamics.

The conventional gas turbines require tuning to minimize combustion dynamics and emissions. This tuning is performed locally. The engineer must therefore be present on-site at the location of the turbine to tune the turbine. Often, the engineer must wait around for other subsystems to become ready to tune the turbine.

It would thus be beneficial to enable the engineer to tune a turbine from a remote location, thereby resulting in improved productivity.

BRIEF SUMMARY OF THE INVENTION

In an exemplary embodiment of the invention, a system for tuning a turbine comprises a turbine controller operatively coupled to the turbine, a first computer system operatively coupled to the turbine controller and located locally to the turbine, and a second computer system for exchanging data with the first computer system that is located remotely from the turbine. The first computer system and the second computer system exchange data over a network connection such as an intranet, the internet or a virtual private network. The first computer system comprises an on-site monitor and the second computer system comprises a local area network having a workstation, and the first computer system is capable of exchanging data with the workstation via the on-site monitor. The on-site monitor exchanges data with the turbine controller using a first protocol and exchanges data with the second computer system using a second protocol different than the first protocol. The first computer system is capable of transmitting data relating to a characteristic of the turbine to the second computer system such as combustion dynamics and/or emissions of the turbine. The second computer system is capable of receiving input from a system user and transmitting control data relating to turbine fuel splits and reflecting the input from the system user to the first computer system. The first computer system is capable of providing the control data to the turbine controller to tune the turbine in accordance with control data.

In another exemplary embodiment of the invention, a method of tuning a turbine comprises providing a turbine controller that is operatively coupled to the turbine, operatively coupling a first computer system to the turbine controller and locating the first computer system locally to the turbine, and exchanging data between the first computer system and a second computer system that is located remotely from the turbine to enable the turbine to be tuned. The data exchange between the first computer system and the second computer system is accomplished over a network connection such as an intranet, the internet or a virtual private network. The first computer system exchanges data with the turbine controller using a first protocol and exchanges data with the second computer system using a second protocol different than the first protocol. The method further comprises transmitting data relating to a characteristic of the turbine such as combustion dynamics and/or emissions from the first computer system to the second computer system. The method further comprises transmitting control data from the second computer system to the first computer system, the control data reflecting input to the second computer system from a system user, and providing the control data received by the first computer system to the turbine controller to tune the turbine in accordance with the control data. In an exemplary embodiment, the control data relates to setting fuel splits of the turbine.

By enabling the engineer to tune the turbine from a remote location, the present invention provides a significant improvement in productivity. For example, the same engineer could tune differently located turbines from a single point in an automated fashion and the frequency of tunings can be increased. Furthermore, long term monitoring of a turbine can be enhanced.

In yet another exemplary embodiment of the invention, a system comprises a first turbine, a first turbine controller operatively coupled to the first turbine for transmitting data relating to a characteristic such as combustion dynamics and/or emissions of the first turbine to a remote location over a network connection. The system further comprises a second computer system located at the remote location from the turbine for receiving data transmitted from the first computer system over the network connection. The network connection comprises an intranet, the internet or a virtual private network. The system further comprises a second turbine and a second turbine controller operatively coupled to the second turbine and to the first computer system.

In yet another exemplary embodiment of the invention, a method of tuning a turbine comprises providing a first turbine, operatively coupling a first turbine controller to the first turbine, transmitting data relating to a characteristic such as combustion dynamics and/or emissions of the first turbine to a location remote from the first turbine over a network connection. The network connection comprises an intranet, the internet or a virtual private network. The first turbine specifically transmits the data to a second computer system located remotely from the turbine so that an evaluation of the transmitted data can be made and any necessary changes to the turbine can be communicated (e.g., by telephone) to a person on-site of the turbine. The method further comprises providing a second turbine, operatively coupling a second turbine controller to the second turbine, transmitting data relating to a characteristic of the second turbine to the location remote from the first turbine over the network connection, the location remote from the first turbine also being remote from the second turbine. Multiple turbines at one location can therefore be controlled by a remote engineer.

In yet another exemplary embodiment of the present invention, a system comprises a first turbine, a first turbine controller operatively coupled to the first turbine, a first computer system operatively coupled to the first turbine controller and located locally to the first turbine, a second turbine, a second turbine controller operatively coupled to the second turbine, a second computer system operatively coupled to the second turbine controller and located locally to the second turbine, and a third computer system for exchanging data with the first computer system and the second computer system. The third computer system is located remotely from the first and second turbines and the first and second turbines are located remotely from each other. The third computer system exchanges data with the first computer system and the second computer system via a network connection such as an intranet, an internet or a virtual private network. The first computer system is capable of transmitting data relating to combustion dynamics and/or emissions of the first turbine to the third computer system and the second computer system is capable of transmitting data relating to combustion dynamics and/or emissions of the second turbine to the third computer system. The third computer system is capable of receiving the inputs from a system user and transmitting control data to the first computer system and the second computer system reflecting the inputs from the system user. The first computer system is capable of providing control data to the first turbine controller to tune the first turbine accordingly, and the second computer system is capable of providing control data to the second turbine controller to tune the second turbine accordingly. The control data transmitted from the third computer system to the first computer system relates to setting fuel splits of the first turbine and the control data transmitted from the third computer system to the second computer system relates to setting fuel splits of the second turbine.

BRIEF DESCRIPTION OF THE DRAWINGS

These, as well as other advantages of this invention, will be more completely understood and appreciated by careful study of the following more detailed description of the presently preferred exemplary embodiments of the invention taken in conjunction with the accompanying drawings, in which:

FIG. **1** is a schematic diagram illustrating a conventional gas turbine system;

FIG. **2** is a schematic diagram illustrating a gas turbine system that is operatively connected to and exchanges data with a remote computer system according to an exemplary embodiment of the present invention;

FIG. **3** is a schematic diagram illustrating a gas turbine system that is operatively connected with and transmits data to a remote computer system according to another exemplary embodiment of the present invention;

FIG. **4** is a schematic diagram illustrating a gas turbine system having multiple turbines operatively coupled to a local computer system that is operatively connected to a remote computer system according to another exemplary embodiment of the present invention.

FIGS. **5**A and **5**B form a schematic diagram illustrating multiple gas turbine systems that are remote from each other and are operatively connected to a remote computer system according to another exemplary embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

FIG. **2** illustrates an exemplary embodiment of a remotely tuned gas turbine system in accordance with the present invention. The system includes a gas turbine **200** having a plurality of combustion chambers **201**, pressure transducers **203***a*, **203***b* respectively installed in the combustion chambers **201**, an emissions sensor **207** installed in each of the combustion chambers **201** and a fuel manifold (not shown). The pressure transducers **203***a*, **203***b* measure the pressure within each of combustion chambers of the turbine **200** and thus provide a measure of the combustion dynamics of the turbine **200**. The emission sensors **207** (one shown) measure the amount of substances such as NO_X and CO in the exhaust of the combustion chambers **201** of the gas turbine **200**. The fuel manifold enables the distribution of the fuel provided to the turbine **200** to be split in a controlled manner.

The system further includes analog to digital A/D converters **205***a*, **205***b*, **209**, a tuning kit **230**, an on-site monitor (OSM) **250**, and a turbine controller **210**. The A/D converters **205***a*, **205***b*, **209**, the tuning kit **230**, the OSM **250** and the turbine controller **210** effectively form a computer system that is located locally to the turbine **200**. The A/D converters **205***a*, **205***b*, the tuning kit **230** and the OSM **250** operatively communicate (i.e., exchange data) with each other using a shared protocol (e.g., an Ethernet protocol). The OSM **250** and the turbine controller **210** communicate with each other using the same or a different protocol (e.g., an Arcnet protocol).

The A/D converters **205***a* and **205***b* are connected to the pressure transducers **203***a* and **203***b*, respectively, to receive the analog signals reflecting the raw data measurements of the pressure transducers **203***a*, **203***b* and to convert the analog signals into digital data. The tuning kit **230** runs a computer program that collects the digital data from the A/D converters **205***a*, **205***b*. The program run by the tuning kit **230** also performs signal processing on the digital data and generates a FFT having amplitude and frequency data from which maximum amplitudes and frequencies of combustion dynamics can be determined.

A/D converters **209** (one shown) are connected to emissions sensors **207**, respectively, to receive the analog signals reflecting the raw data measurements of the emissions sensors **207** and to convert the analog signals into digital data. The digital data from the A/D converters **209** is provided to the turbine controller **210**. The turbine controller **210** forwards corresponding data relating to the measurements by the emissions sensors **207** to the OSM **250** using an Arcnet protocol.

The remotely tuned turbine system also includes a remote network **240** which is remotely located from the gas turbine **200**. The network **240** may be formed by, for example, a local area network (LAN) or a wide area network (WAN). The gas turbine **200** and the remote network **240** can be located in different cities. In the exemplary embodiments discussed below, the network **240** is formed by a LAN **240**, although those skilled in the art will appreciate that other remote networks such as a WAN may be implemented. The LAN **240** includes a server **245** that is operatively connected to a plurality of workstations **241, 243** which also may be located remotely from each other such as in different cities. The LAN **240** is capable of communicating with the OSM **250** over a network connection such as the internet, an intranet or a virtual private network (VPN). Specifically, data can be exchanged with the locally located OSM **250** and the remotely located server **245** of the LAN **240**. The server **245** in turn exchanges data with at least one of the workstations **241, 243**. The OSM **250** thus serves as a hub that allows the remotely located workstations **241, 243** to communicate with the computer system that is locally located to the turbine **200** through the server **245** and the network connection.

After the tuning kit **230** has generated the frequency and amplitude data, the tuning kit **230** provides this processed data to the OSM **250** using an Ethernet protocol. The OSM **250** then transmits the data over the network connection to the server **245**. Additionally (or in the alternative), data relating to the measurements of the emission sensors **207** is provided from the turbine controller **210** to the OSM **250** using an Arcnet protocol. The OSM **250** then transmits the data over the network connection to the server **245** using an Ethernet protocol. The server **245** provides this data it has received to one or more of the workstations **241, 243** so that a system user (e.g., an engineer at workstation **241** or **243** as illustrated in FIG. **2**) can interpret the data. The user can determine whether any necessary changes, such as adjustments to the fuel splits provided by the fuel manifold of the turbine system, that need to be made to the turbine to improve its performance.

If the system user determines that changes need to be made to the turbine **200**, the system user can input these changes into one of the workstations **241, 243**. Control data reflecting these changes, such as fuel split control data, is transmitted from one of the workstations **241** or **243** by a computer program running on the workstations **241, 243** to the server **245**. This data is then transmitted over the network connection to the OSM **250**. The input provided into one of the workstations **241** or **243** is displayed on the other workstations **243** or **241** of the LAN **240** so that other system users can be informed of the input.

The OSM **250** runs a program that sends the control data to the turbine controller **210** using an Arcnet protocol. The program run by the OSM **250** also ensures the remote workstations **241, 243** are operatively connected thereto. The turbine controller **210**, preferably a Mark V turbine controller, is connected to and exchanges data with the turbine **200**. After the turbine controller **210** receives the control data from the OSM **250**, it sends corresponding signals to the turbine **200** to tune the settings of the turbine. For example, the turbine controller **210** can transmit signals reflecting new fuel split settings in accordance with the input provided by the system user at one of the remote workstations **241, 243**. An engineer located on-site of the turbine **200** can verify proper operation of the turbine system.

After the turbine **200** adjusts to the new settings dictated by the turbine controller **210**, another set of pressure measurements and/or emissions measurements can be made by the pressure transducer **203***a*, **203***b* and/or emissions sensor **207** to determine the combustion dynamics and/or emissions of the turbine **200**. In the same manner discussed above, the data relating to these measurements can be transmitted by the OSM **250** over the network connection to the remotely located LAN **240**. Further evaluation of the results by the system user and subsequent tuning of the turbine as discussed above is repeated until a map of combustion dynamics and/or emissions as a function of fuel splits is developed. From this map, the optimum fuel split settings can be determined so that the lowest emissions and lowest combustion dynamics can be attained.

The present invention thus enables a remotely located system user to tune a turbine. Significant improvements in the user's productivity can be obtained, for example, by eliminating the need for the user to travel to the turbine site.

FIG. **3** illustrates another exemplary embodiment of a gas turbine system that is operatively connected to a remotely located LAN **240**. In this and all following embodiments, reference numbers corresponding to parts described in previous embodiments shall remain the same. Only the differences from the previous embodiment(s) shall be discussed in detail.

In the exemplary embodiment illustrated in FIG. **3**, data relating to combustion dynamics and/or emissions of the gas turbine **200** are transmitted over the network connection to the LAN **240** as discussed above. However, after a system user (e.g., a remotely located engineer) has evaluated the data transmitted to the LAN **240** at one of the workstations **241, 243**, the system user will communicate, preferably by telephone, any necessary changes to an engineer who is located on-site of the gas turbine **200**. As discussed above, these changes can include, for example, adjustments to the fuel split settings of the turbine **200**. The on-site engineer will locally perform any necessary tuning in accordance with the instructions communicated by the remote system user. There is thus no need to transmit control data relating to any necessary changes to the turbine over the network connection from the LAN **240** to the OSM **250**.

FIG. **4** illustrates a gas turbine system having multiple (e.g., two) turbines connected to a computer network that is located locally to the turbines according to another exemplary embodiment of the present invention. Specifically, the turbine system illustrated in FIG. **4** includes all of the components of the turbine system illustrated in FIG. **2**. However, the gas turbine system further includes a second gas turbine **200***a* having a plurality of combustion chambers **201***a*, a plurality of pressure transducers **203***c*, **203***d* respectively installed in the combustion chambers **201***a*, emissions sensors **207***a* (one shown) respectfully installed in the combustion chambers **201***a* and a fuel manifold (not shown). The pressure transducers **203***c*, **203***d* are respectively connected to A/D converters **205**c, **205**d. A/D converters **209**a (one shown) are respectively connected to the emissions sensors **207**a. The output of the A/D converters **209**a are provided to turbine controller **210**a which exchanges data with OSM **250** using an Arcnet protocol.

The structure and operation of gas turbine **200**a and its operatively connected components are similar to gas turbine **200** and its corresponding operatively connected components. As illustrated in FIG. **4**, both of the turbines **200**, **200**a are operatively connected to the same tuning kit **230** and OSM **250**. The OSM can thus exchange data with the LAN **240** over the network connection to tune both turbines **200**, **200**a. The turbine **200** and **200**a are located locally to each other and are located remotely from the LAN **240**.

As will be appreciated by those skilled in the art, the system disclosed in FIG. **4** can be modified in accordance with the embodiment of FIG. **3**. That is, the system illustrated in FIG. **4** can be modified so that a system user at one of the remote workstations **241** or **243** can evaluate data received over the network connection from the turbines **200**, **200**a and communicate instructions to (e.g., by telephone) an on-site engineer to perform local tuning of the turbines **200**, **200**a.

FIGS. **5**A–**5**B illustrate multiple gas turbine systems that are each operatively connected to the LAN **240** in accordance with another exemplary embodiment of the present invention. The turbine systems are located remotely from each other and are both located remotely from the LAN **240**. For example, each of the gas turbine systems and the LAN **240** can be located in different cities.

The first turbine system includes turbine **200** and all of the other components discussed in the embodiment of FIG. **2**. The second gas turbine system includes a gas turbine **300** having a plurality of combustion chambers **301**, a plurality of pressure transducers **303**a, **303**b respectively installed in the combustion chambers **301**, emissions sensors **307** (one shown) respectively installed in the combustion chambers **301** and a fuel manifold (not shown). The second gas turbine system further includes A/D converters **305**a, **305**b, **309**, a tuning kit **330**, an OSM **350** and a turbine controller **310**. The pressure transducers **303**a, **303**b and emissions sensors **307** measure the pressure and emissions of the turbine **301**, respectively, in a manner similar to pressure transducers **203**a, **203**b and emission sensors **207**. The raw data from the measurements of the pressure transducers **303**a, **303**b and emissions sensors **307** are processed and output by the A/D converters **305**a, **305**b, **309** to the tuning kit **330** and the turbine controller **310** and later transmitted by OSM **350** in a manner similar to corresponding parts (A/D converters **205**a, **205**b, **209**, turbine controller **210**, tuning kit **230** and OSM **250**) of the first turbine system. Accordingly, the OSMs **250**, **350** are both capable of exchanging data with LAN **240** over the network connection to tune turbines **200**, **300**, respectively. The system user at one of the workstations **241**, **243** can thus tune each of the turbines **200**, **300** from a single location remote from both of the turbines **200**, **300**. The engineer thus does not need to unnecessarily travel between the locations of the turbines **200**, **300** and therefore can tune turbines **200**, **300** with enhanced efficiency.

The exemplary embodiment disclosed in FIGS. **5**A and **5**B can be modified in accordance with the embodiment of FIG. **3**. That is, after the system user at one of the workstations **241**, **243** evaluates data that has been transmitted over the network connection relating to the measurements performed at the turbines **200**, **300**, the system user can communicate any necessary changes, (e.g., by telephone) to respective on-site engineers at the locations of the turbines **200**, **300** for local tuning. Thus, no control data needs to be transmitted back from the LAN **240** to the OSMs **250**, **350** over the network connection to tune turbines **200**, **300**.

While the invention has been described in connection with what is presently considered to be the most practical and preferred embodiment, it is to be understood that the invention is not to be limited to the disclosed embodiment, but on the contrary, is intended to cover various modifications and equivalent arrangements included within the spirit and scope of the appended claims.

What is claimed is:

1. A system for tuning a gas turbine comprising:

a turbine controller operatively coupled to the gas turbine;

a first computer system operatively coupled to the turbine controller and located locally to the gas turbine; and

a second computer system for exchanging data with the first computer system, the second computer system being located remotely from the gas turbine;

wherein the first computer system is capable of transmitting data relating to combustion dynamics and/or emissions of the gas turbine to the second computer system, and the second computer system is capable of receiving user input in response to the data transmitted from the first computer system and transmitting control data reflecting the received user input to the first computer system to enable the turbine controller to tune fuel split settings of the gas turbine.

2. The system of claim **1** wherein the first computer system and the second computer system exchange data over a network connection.

3. The system of claim **2** wherein the network connection comprises an intranet, an internet or a virtual private network.

4. The system of claim **2** wherein the first computer system comprises an on-site monitor and the second computer system comprises a local area network having a workstation, the first computer system being capable of exchanging data with the workstation via the on-site monitor.

5. The system of claim **4** wherein the on-site monitor exchanges data with the turbine controller using a first protocol and the on-site monitor exchanges data with the second computer system using a second protocol different than the first protocol.

6. A method of tuning a gas turbine comprising:

providing a turbine controller that is operatively coupled to the gas turbine;

operatively coupling a first computer system to the turbine controller and locating the first computer system locally to the turbine;

transmitting data relating to combustion dynamics and/or emissions of the gas turbine from the first computer system to a second computer system that is located remotely from the gas turbine;

transmitting control data from the second computer system to the first computer system, the control data reflecting user input to the second computer system; and

processing the control data received by the first computer system to enable the turbine controller to tune fuel split settings of the gas turbine.

7. The method of claim **6** wherein exchanging data between the first computer system and the second computer system is accomplished over a network connection.

8. The method of claim 7 wherein the network connection comprises an intranet, an internet or a virtual private network.

9. The method of claim 7 wherein the first computer system exchanges data with the turbine controller using a first protocol and exchanges data with the second computer system using a second protocol different than the first protocol.

10. A system comprising:

a first gas turbine;

a first turbine controller operatively coupled to the first gas turbine; and

a first computer system operatively coupled to the first turbine controller for transmitting data relating to combustion dynamics and/or emissions of the first gas turbine to a remote location over a network connection, and processing control data received over the network connection in response to the transmitted data relating to the combustion dynamics and/or emissions of the first gas turbine and processing the control data to enable the first turbine controller to tune fuel split settings of the first gas turbine.

11. The system of claim 10 further comprising a second computer system located at the remote location from the gas turbine for receiving data transmitted from the first computer system over the network connection.

12. The system of claim 11 wherein the network connection comprises an intranet, an internet or a virtual private network.

13. The system of claim 10 further comprising a second gas turbine and a second turbine controller operatively coupled to the second gas turbine and to the first computer system.

14. A method of tuning at least one gas turbine utilizing a first computer system comprising:

providing a first gas turbine;

operatively coupling a first turbine controller to the first turbine;

transmitting data relating to combustion dynamics and/or emissions of the first gas turbine to a location remote from the first turbine over a network connection;

receiving control data over the network connection in response to the transmitted data relating to the combustion dynamics and/or emissions of the gas turbine; and

processing the received control data to enable the first gas turbine controller to tune fuel split settings of the first gas turbine.

15. The method of claim 14, wherein transmitting the data to the location remote from the first gas turbine comprises transmitting the data to a second computer system located remotely from the first gas turbine.

16. The method of claim 15, further comprising:

receiving the transmitted data relating to combustion dynamics and/or emissions of the first gas turbine at the second computer system;

evaluating the processed data to determine any changes that need to be made to an operation of the first gas turbine;

communicating any necessary changes to a person located on-site of the first gas turbine; and

changing a setting of the first gas turbine in accordance with the necessary changes communicated to the person on-site of the first gas turbine.

17. The method of claim 15 wherein transmitting the data over the network connection comprises transmitting data over one of an intranet, an internet and a virtual private network.

18. The method of claim 14 further comprising:

providing a second gas turbine;

operatively coupling a second turbine controller to the second gas turbine; and

transmitting data relating to combustion dynamics and/or emissions of the second gas turbine to the location remote from the first gas turbine over the network connection, the location remote from the first gas turbine also being remote from the second gas turbine.

19. A system comprising:

a first gas turbine;

a first turbine controller operatively coupled to the first gas turbine;

a first computer system operatively coupled to the first turbine controller and located locally to the first gas turbine;

a second gas turbine;

a second turbine controller operatively coupled to the second gas turbine;

a second computer system operatively coupled to the second turbine controller and located locally to the second gas turbine;

a third computer system for exchanging data with the first computer system and the second computer system, the third computer system being located remotely from the first and second gas turbines;

wherein the first computer system transmits data relating to combustion dynamics and/or emissions of the first gas turbine to the third computer system and the second computer system transmits data relating to combustion dynamics and/or emissions of the second gas turbine to the third computer system; and

the third computer system receives user input and transmits control data to the first computer system and the second computer system corresponding to the received user input, and the first computer system processes the control, data to enable the first turbine controller to tune fuel split settings of the first gas turbine and the second computer system processes the control data to enable the second turbine controller to tune fuel split settings of the second gas turbine.

20. The system of claim 19 wherein the first and second gas turbines are located remotely from each other.

21. The system of claim 19 wherein the third computer system exchanges data with the first computer system and the second computer system via a network connection.

22. The system of claim 21 wherein the network connection comprises an intranet, an internet or a virtual private network.

* * * * *